

REMARKS/ARGUMENTS

As Applicants have consistently stated, the invention claimed in this Application involves the imprinting of a plurality of functional moieties on inorganic oxides, including both surface imprinting and imprinting of a bulk material. The nature of imprinting itself is given in the first sentence of the Katz et al. 2000 publication in *Nature*: "Molecular imprinting aims to create solid materials containing chemical functionalities that are spatially organized by covalent or non-covalent interactions...." That is, "imprinting" in the context of this invention, is the production of a plurality of functional groups that are organized in a non-random pattern. While Applicant's position remains that this definition of "imprinting" is inherent in the claims, several claims have been amended to specifically include this feature. Applicants submit that such amendment moots many comments of the examiner in the Office Action that arguments are directed to features not claimed.

Applicants note that the claimed process enables both the imprinting of two or more different functional groups within the same site, or four or more functional groups of the same type at the same site. Neither of these results is obtained in any cited reference.

This invention is concerned with covalent imprinting; by contrast, non-covalent imprinting is known to suffer from strong heterogeneity, having a relatively small number of sites that are uniform but with the majority of sites being randomly arranged.

The present invention further provides means for covalently imprinting more than three functional groups (which may be the same or different) on an oxide substrate, as well as for imprinting two or more different functional groups on such a material. Neither of these objectives is achieved by the cited prior art.

The invention utilizes the incorporation of thermally labile groups in the imprinting molecule and their removal by thermolysis. With one exception, the cited art does not use such a technique.

Rejections over prior art

Claims 56-58, 62, 63, 65, 66, 70 and 72 are rejected as anticipated by Markowitz et al. The Examiner has referred specifically to col. 11 line 62 - col. 12 line 9 of the reference.

However, Markowitz et al. do not disclose imprinting of functional moieties and do not disclose imprinting in an organized fashion on a bulk oxide. There is no discussion in the reference of producing organized imprints.

The process of this reference initially produces a material having unfunctionalized pores - not functional groups - that are randomly distributed respective to each other. As stated in the patent, at col. 5 lines 15-17 and 41-52, what is "imprinted" in the substrate is not any functional groups, but rather "negative images" or "pores, channels or other types of voids corresponding to the shape of the supramolecular structure" (of the imprinting compound). Functional groups may be attached to the pores later. However, as discussed above, these functional groups are still distributed in a random fashion, not in an organized pattern.

Specifically, with respect to claims 56-58, the reference does not disclose a bulk inorganic oxide imprinted with one or more isolated functional moieties; the pores of the reference and any functional groups later added are randomly distributed. Further with respect to claim 58, the reference does not disclose production of a bulk inorganic oxide having a plurality of voids, each having a plurality of amine groups imprinted. Contrary to the statement in the Office Action, claim 58 specifically recites that the bulk inorganic oxide contains a plurality of voids.

With regard to claims 62, 63, 65, 66, 70 and 72, the reference does not disclose an inorganic substrate having four or more imprinted moieties. Again, "imprinting" in the context of the present invention refers only to moieties arranged in a non-random pattern. Markowitz et al. do not disclose this, and do not accomplish it.

Markowitz et al., in fact, is an example of surface-functionalized material, which, as stated above, does not aim at providing an organized non-random pattern of functional groups.

Withdrawal of the rejection of claims as anticipated by Markowitz et al is respectfully requested.

Claims 1-9, 11, 12, 16, 17, 20-22, 34, 35, 40, 42, 56-58, 62, 63, 65-67, 70 and 72 are rejected as anticipated by Katz et al. (*Nature*, 2000). The examiner refers to Figure 1 of this publication.

Katz et al. disclose only a process involving imprinting via chemical deprotection. Claim 1-9, 11, 12, 16, 17, 20-22, 34, 35, 40, and 42 all require thermal deprotection (thermolysis) and/or the inclusion of thermally labile moieties in the product. As pointed out later in the Office Action, Katz et al. do not disclose this. These claims therefore are not anticipated by Katz et al.

The examiner believes that because Katz et al. discloses that three different temperatures are referred to for deprotection, there must be three different functional groups in the Katz material. However, that is not the case, as shown by the Katz imprinting molecule, on p. 286. All three imprinting and imprinted groups are the same.

Figure 1 of Katz et al. discloses the production of an inorganic oxide with three imprinted functional groups, using an imprinting compound that can produce such a product. Claims 62, 63, 65-67, 70 and 72 all call for a product having four or more imprinted functional groups. These claims are thus not anticipated by Katz et al. Claims 56-58 call for an imprinted hydrophilic bulk inorganic oxide; however, the use of TMSI as the silica source, as in Katz et al., results in the capping of the silica surface with hydrophobic trimethylsilyl functional groups. Consequently this reference does not teach production of a hydrophilic product.

In addition, and more to the point, Katz do not employ any thermally labile groups and employ chemical, not thermal, deprotection, to produce the end product. The Katz et al. technique is discussed in the specification on pages 2-4, paragraphs 4 and 5, and is not the technique claimed herein.

Withdrawal of the rejection of claims as anticipated by Katz et al. is respectfully requested.

Claims 34, 35, 38-40, 42, 56-58, 62-70 and 72 are rejected as anticipated by Davis et al. The Examiner refers specifically to Figure 13, structure 9 and Figure 15. Again, this reference does not show an inorganic oxide imprinted with four or more functional groups (claims 34, 35, 38-40, 42). The reference further does not show imprinting on a hydrophilic inorganic oxide and, with respect to figure 15, shows only imprinting of two amino groups on the surface of a silica (cf. claims 56-58, 62-70 and 72).

The examiner contends that this argument refers to features that are not contained in the rejected claims, namely hydrophilic groups and different functional groups. To the contrary, as discussed above, claim 58 specifically calls for hydrophilic groups. In addition, Applicants have not argued that the claims call for four different functional groups. The claims simply call for four functional groups. Davis, like Katz et al., can only imprint with a maximum of three groups due to the nature of the imprinting molecule (being based on a benzene ring). Davis is not capable of imprinting with four groups.

Claims 1, 2, 4-9, 11, 12, 17, 20, 34-37, 39, 40, 56-58, 62, 63, 65-67, 69, 70 and 72 are rejected as anticipated by Ki et al.

Ki et al. is discussed in the specification at p. 11, paragraph 36. With respect to the process claims 1, 2, 4-9, 11, 12, 17, and 20, Ki et al. used an imprinting compound with only a single functional moiety whereas the aforesaid claims call for use of an imprinting compound having a plurality of functional moieties. With respect to claims 34-37, 39, and 40, Ki et al. produce a silica having only a single imprinted moiety. In apposition to claims 56 and subsequent, Ki et al. could not produce an imprinted bulk product at all, but had to settle for a surface-imprinted product (see the last paragraph in the right-hand column of p. 14838).

In view of the specific disclosure of Ki et al. to producing an estrogen-imprinted silica moiety and its use of a reversible reaction in so doing, those skilled in the art would not have found it obvious to extend the work to other types of imprinting. Ki et al. cannot be used to render any of the current claims obvious, either in and of itself, or with any other pieces of cited art.

Again the examiner contends that the previous arguments relied on a distinction not in the claims, namely the provision of four different imprinting groups. However, Applicants have not made this argument. The argument is that Ki et al. do not disclose a product having a patterned imprinting of four functional groups, whether they be the same or different.

Withdrawal of the rejection of claims as anticipated by Ki et al. is respectfully requested.

Claims 56-58, 60-63, 65-67, 70, 72 and 73 stand rejected as anticipated by Dai et al. (Angew. Chem.) The Examiner refers specifically to p. 1236, left column, middle section and to Figure 2.

Claims 56-58, 60 and 61 call for imprinted bulk oxides. Dai et al. however, imprint only on the surface of their oxides. See the first sentence of the middle paragraph of p. 1236 and the caption for Figure 2(A). Claims 62, 63, 65-67, 70, 72 and 73 all call for imprinting with four or more functional moieties, but Dai et al. imprint only with pairs of imprinting compounds or moieties, each producing an imprint of a single functional moiety, so this reference does not meet this limitation. The examiner contends that the previous argument was based on the process involving four different functional groups, this not being recited in the claims. However, this is not the case; the argument is based on the imprinting with functional groups in groups of four, which is not disclosed in the reference.

Withdrawal of the rejection of claims as anticipated by Dai et al. is respectfully requested.

Claims 56-58, 60-63, 65-67 and 69-73 stand rejected as anticipated by Dai et al.

II. The examiner points to Figures 1A and 1B

However, this reference, like the others, does not anticipate the claims. As to claims 56-58, 60 and 61, this reference, like Dai et al. I, discloses only surface, not bulk, imprinting. See col. 2 lines 59-61, for instance. With respect to the remaining claims, as is the case with Dai et al., this reference again imprints only with single imprinting moieties having a single functional moiety per imprinting group. Note that in Fig. 3, each imprinting moiety retains the central nitrogen-nitrogen bridging group so that each imprinting moiety provides only one imprinted functional moiety - an NH group.

Withdrawal of the rejection of claims as anticipated by Dai et al. II is respectfully requested.

Claims 10, 13-15 and 64 stand rejected as obvious over Katz et al. The Examiner properly understands that Katz et al. lack any disclosure of thermolysis. However, the language of the rejection seems to imply that the examiner believes that all that is lacking in the reference is a disclosure that thermolysis may occur at higher temperatures.

Applicants submit that the Katz et al. disclosure is explicitly limited to a process that involves chemical deprotection of the functional groups by bond cleavage with chlorotrimethylsilane. Those skilled in the art simply would not conceive of using thermolysis instead of chemical deprotection, or of constructing the imprinting compound so as to be suitable for deprotection by thermolysis, in such a process. There is no basis in the art for replacing the chemical deprotection specifically used by Katz et al. with providing a plurality of thermally labile protecting groups and using thermolysis for the deprotection stage.

The examiner points to the language in Katz et al. respecting higher temperatures needed to effect deprotection of multiple point materials. Again, the deprotection disclosed in this reference is chemical, not thermal deprotection. Higher temperatures simply were needed for the chemical deprotection of double or triple imprinting molecules.

Withdrawal of the rejection of claims for obviousness over Katz et al. is respectfully requested.

Finally, claims 18, 19, 23-27, 30-33, 41, 43-55 and 59 are rejected as obvious over the combination of Katz et al. with Dai et al. II. The examiner points out that Katz et al. do not disclose using a mixture of ligands but that Dai et al. II disclose using a variety of ligands in their process.

Applicants agree that Katz et al. do disclose only a single type of imprinted functional group using a single type of imprinting compound. The same is true of Dai et al. While this reference does contain a lengthy list of the ligands that may be used, the reference process always uses only a single ligand. The process as described, and all of the examples, uses a metal ion having a pair of identical ligands bound to it. There is no disclosure whatever of using a mixture of ligands.

In addition, the two references disclose different imprinting processes, using different types of reagents under different conditions. The combination of references would not have been made by those skilled in the art, and in any event, would not produce the claimed invention.

Withdrawal of the rejection of claims as obvious over Katz et al. in view of Dai et al. II is respectfully requested.

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Reply to Office Action of October 17, 2006

PATENT

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-576-0200.

Respectfully submitted,

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